

NATIONAL TRANSPORTATION SAFETY BOARD
Vehicle Recorder Division
Washington, DC 20594

January 23, 2023

Onboard Image Recorder and Audio Transcript

Specialist's Factual Report
By Sean Payne

1. EVENT

Location: Williams, AZ
Date: April 15, 2021
Aircraft: Cessna 140, N2506N
Operator: Private
NTSB Number: WPR21LA166

2. GROUP

A group was not convened.

3. DETAILS OF INVESTIGATION

On April 27, 2021, the National Transportation Safety Board (NTSB) Vehicle Recorder Division received the following image recorder:

Recorder Manufacturer/Model: **Canon EOS M50**
Recorder Serial Number: **922030000709**
Location: **Cockpit**

Recorder Manufacturer/Model: **GoPro HERO 5**
Recorder Serial Number: **C3161354609771**
Location: **Cockpit**

Recorder Manufacturer/Model: **GoPro HERO 5**
Recorder Serial Number: **C3161355736531**
Location: **Mounted to Left Wing**

3.1. Recorder Description

Canon EOS M50

The Canon EOS M50 is a consumer grade 24.1 megapixel mirrorless camera. It contains a CMOS image sensor with an extended ISO range of up to 25,600. It has a sophisticated autofocus system and can accept a wide range of lenses designed for the EOS-C camera family. It can record full HD video up to 24 frames per second (fps) at 4K resolution.¹ Still images can be captured at a rate up to 10 fps. The EOS M50 has the option to allow an external GPS sensor to be added so that each image file can be geo-tagged with a GPS position and timing data.

GoPro HERO 5

The GoPro HERO is a compact, lightweight, POV digital camera enclosed in a ruggedized housing that allows the camera to be mounted in a variety of positions using an array of supported accessories.² Depending on the model, the camera supports 4K HD at 60 fps as well as other lower quality recording resolutions at higher frame rates.³ The camera can be set to record still images simultaneously or independently of a video stream. The camera includes a wide-angle aspherical f/2.8 glass lens that provides a maximum of 170 degrees viewing angle. The camera supports recording to microSD cards.⁴ A built in Wi-Fi module allows users to connect to the camera either via an accessory remote control or via a smart phone app that permits camera control and image transfer.

3.2. Recorder Damage

Canon EOS M50 (Cockpit)

The camera sustained impact damage. The lens and the unit's internally mounted flash were displaced. The camera's condition is shown in figure 1. The memory card was undamaged, also shown in figure 1.

¹ 4K – A resolution format of 3840 x 2160 pixels.

² POV – Point of View Shot – A photography technique that records the character's viewpoint from a singular camera location mounted in a manner that represents the character's field of view.

³ HD – High Definition – A resolution generally consisting of greater than 480 lines of horizontal resolution.

⁴ SD – Secure Digital – a standard for nonvolatile memory card used in portable devices.



Figure 1. The Canon EOS M50, as received.

GoPro HERO 5 (Cockpit)

This camera was labeled as having been found in the cockpit. The camera sustained minor impact damage but was largely intact. The camera's microSD card was in good condition and was able to be read with a PC. The device and associated microSD card are shown in figure 2.



Figure 2. The GoPro recovered from the aircraft's cockpit.

GoPro HERO 5 (Left Wing)

This camera was labeled as having been found in the vicinity of the left wing. The camera sustained minor impact damage but was largely intact. The camera's microSD card was in good condition and was able to be read with a PC. The camera's mounting device was broken. The device and associated microSD card are shown in figure 3.



Figure 3. The GoPro recovered from the aircraft's left wing.

3.3. Electronic Files

Each device's memory card contained a number of recordings, the nature of the relevant files is discussed in Section 3.5, Summary of Recording Contents. In general, each device's associated media card contained recordings 1920 x 1080 pixels in resolution with an associated audio track. The audio was recorded from the camera's internal microphone and there was no evidence that the devices were wired to collect audio from the aircraft's audio panel.

3.4. Timing and Correlation

Timing of the summary and transcribe audio is expressed as mountain standard time (MST). The timing was correlated by comparing ADS-B data from the aircraft's arrival to H.A. Clark Memorial Field Airport (KCMR), Williams, Arizona with the elapsed time of the wing mounted GoPro camera.

3.5. Summary of Recording Contents

In agreement with the Investigator-In-Charge, a video group did not convene, and a summary report was prepared.

Canon EOS M5

The memory card associated with the Canon EOS M50 contained a number of recordings on a multitude of different dates and times. The camera's timestamp was unable to be validated. The majority of these recordings were aeronautical in nature, but were determined not to be pertinent to the accident investigation.

The last five video recordings were of the accident aircraft and were captured at a location consistent with the features of Sedona Airport, Sedona, Arizona (KSEZ). The lighting conditions present were consistent with the departure time of the leg previous to accident flight (Sedona to Williams). External views of the accident aircraft on the ground were captured, and later, a cockpit view during departure

from a location consistent with KSEZ was captured. Nothing about these recordings was anomalous. Additionally, portions of the intra-cockpit recording that captured the aircraft's instrument panel showed the tachometer functioning in a manner consistent with the recorded sound of the engine's RPM.

GoPro HERO 5 Cockpit

There were a handful of video files on the device. The time and date stamp of each file was unable to be validated. The recordings showed the accident aircraft and accident pilot operating from an airport environment consistent with Bermuda Dunes Airport, Palm Springs, California, (KUDD) and the surrounding region. The recordings were reviewed and were determined not to be pertinent to the accident investigation.

During high impact scenarios in which a camera system is powered down abnormally, there exists the possibility that accident recordings may not appear in a Windows file system. A forensic search of the associated memory card from this device was conducted and revealed deleted files, but no recordings were associated with the accident flight. Therefore, it is likely this camera was not recording at the time of the accident.

GoPro HERO 5 Left Wing

All times are expressed as mountain standard time (MST).

File GOPR0155.mp4

Date: 4/15/2021, Start Time: 18:43:13

The recording captured the aircraft's start, run up, and departure from a location consistent with KSEZ. Figure 4 is a screen capture illustrating the field of view provided by the wing mounted camera.



Figure 4. A screen capture showing the field of view of the wing mounted camera just after departure from a location consistent with KSEZ.

At 19:00:55, the video file ended while the aircraft was in cruise flight on a heading roughly toward the setting sun. This stoppage was consistent with a GoPro camera filesystem segmenting to a new file due to file storage constraints.

File GP010155.mp4

Date: 4/15/2021, Start Time: 19:00:55

The aircraft continued in cruise flight on a heading toward the setting sun as shown in the previous recording. Around 19:08:22, the aircraft changed heading to the right and began to track a new course. About a minute later, a brief change in engine RPM was audible. The aircraft resumed cruise flight, at an audible engine RPM consistent with what was observed previously and continued on a heading toward the setting sun.

At 19:18:37, the video file ended while the aircraft was in cruise flight on a roughly toward the setting sun. This stoppage was consistent with a GoPro camera filesystem segmenting to a new file due to file storage constraints.

File GP020155.mp4

Date: 4/15/2021, Start Time: 19:18:37

The aircraft appeared to be in cruise flight and headed toward the setting sun. Sun glare was visible low on the horizon toward the front of the aircraft.

Around 19:09:20, an airport beacon was visible. The aircraft continued on a heading toward the airport beacon and began a descent. During the descent, the

amount of visible light reduced and the aircraft was likely operating in night conditions.⁵ By 19:05:07, the aircraft had entered a downwind for the landing runway. The aircraft continued a normal landing pattern and touched down on runway 18 at H.A. Clark Memorial Field Airport (KCMR), Williams, Arizona. At 19:36:19, the video file ended while the aircraft was taxiing to a ramp area. This stoppage was consistent with a GoPro camera filesystem segmenting to a new file due to file storage constraints.

File GP030155.mp4

Date: 4/15/2021, Start Time: 19:36:19

The file is a continuation of the video summarized above and began with the aircraft taxiing to a ramp area at KCMR. By 19:37:30, the aircraft came to a stop in a ramp area in front of a row of T hangars. By 19:37:40, the aircraft had shut down.

At 19:37:54, a sound consistent with an aircraft door being opened was audible. The following section provides a transcription of audible conversation between the pilot and passenger. During the time covered in the transcript, the pilot exited the aircraft and inspected the aircraft with a red beamed flashlight. The pilot was also noted checking the oil and opening the aircraft's right engine cowl.

The transcript of the recorded audio track during this segment begins below. At times, audio enhancement filters were utilized to increase the intelligibility of the recording. At times, the audio became difficult to discern due to the occupants likely being inside the aircraft with the door closed. An asterisk (*) denotes unintelligible words and phrases that were unable to be determined during the transcription exercise. A single asterisk indicates a single unintelligible word. Three asterisks (* * *) indicate up to three unintelligible words or an unintelligible phrase. Words in parenthesis are questionable insertions, which were unable to be definitively transcribed due to the audio quality. The pilot was determined to be the male voice (Pilot) and the passenger was determined to be the female voice (PAX).

19:37:52.7

Pilot okay - just a peek - I'm gonna have you stay seated if you can.

19:37:57.6

PAX thanks hon.

19:38:08.3

Pilot thank you for bearing with me.

19:38:10.7

Pilot * * what's happening.

19:38:17.8

Pilot we got a clean belly that's a good sign. and no oil spewing out anywhere.

⁵ Lighting conditions as recorded by an imaging device is often not representative of the lighting conditions present to the human eye.

19:38:45.4
Pilot * * * .

19:39:35.1
Pilot okay.

19:39:40.0
PAX * * * ?

19:39:42.9
Pilot yeah. because we're gunna continue on at this point.

19:39:45.8
PAX okay.

19:39:46.7
Pilot what happened is - there is a mechanical cable between the engine and this that spins and that spins the rotations. umm- umm- however that cable has not come undone at the engine and as far as I can tell - it is also still attached here. so. what has happened is that the tachometer has failed. and technically by F-A-R regulations we're not supposed to continue without getting a special flight clearance. * * * .

19:40:36.1
PAX what does the tachometer do?

19:40:38.7
Pilot it shows me how fast the prop is turning.

19:40:42.7
PAX are you sure you're okay with that?

19:40:45.4
Pilot yeah - because I'd actually feel safer to (Grand Canyon). there is nothing (really wrong with the way the airplane is flying).

19:40:53.5
PAX okay.

19:40:54.2
Pilot so we're gunna start up.

19:40:56.6
PAX so then * * * .

19:41:00.6
Pilot continue (on). yes.

19:41:01.0
PAX so * * * .

19:41:06.9
Pilot yeah.

19:41:07.9
PAX ohhh.

19:41:08.4
Pilot the gauge itself either stripped out or - failed in some way - internally. and basically tore itself up internally. my main concern was that if - **[sound similar to aircraft door closing]** if cable came loose (motor).

19:41:44.8
PAX are you feeling okay?
19:41:47.5
PAX yeah. I'm fine * * *.
19:41:53.2
Pilot yeah. I'd rather (continue) * * *.
19:42:00.4
PAX * * *.
19:42:03.2
Pilot * * *.

At 19:42:10, the sound of the aircraft starting was noted.

At 19:42:19, the aircraft began taxiing on the ramp area, and by approximately 19:42:59, the aircraft had entered a taxiway parallel to the runway.

At 19:43:26, the runway and taxiway lights shut off while the aircraft was taxiing. At 19:43:29, the airport lighting system turned back on. At 19:43:59, the aircraft's landing light quickly illuminated and then shutoff while the aircraft was taxiing.

At 19:44:46, the aircraft's landing light illuminated again as the aircraft neared a hold short line. By 19:44:49, the aircraft had stopped near the hold short line, the landing light was turned off and the aircraft's engine was audible in a manner similar to an engine run up. The run up continued, consistent with a mag check being performed. The engine run up audio sounded nominal.

By 19:46:53, the aircraft had crossed the hold short line, the landing light was turned on, and the aircraft entered runway 36 at KCMR.

Around 19:47:16, the engine power noise increased, and the aircraft began a takeoff roll. After approximately 1200 feet of ground roll the aircraft became airborne and was flying in ground effect.⁶ By 19:47:48, approximately 2415 feet of runway had been used and the aircraft began to climb out of ground effect. The aircraft continued a climb and had taken a heading to the left of runway 36. The aircraft then appeared to parallel the runway 36 with the runway on the right of the aircraft (aircraft left of centerline, not over the runway).

At 19:48:24, the aircraft began a right turn near the end of the runway. Runway end lights were visible below the aircraft, the altitude did not appear to significantly change. Figure 5 is a screen capture taken at 19:48:25 and illustrates the position of the aircraft in relation to the departure runway and the aircraft's attitude at this

⁶ Ground roll calculations we performed by comparing runway markings to a survey of the airport.

time.⁷ In reference to sparsely illuminated visual references below the aircraft, the aircraft had continued in a right turn through 19:48:31.

Figures 5-8 include an overlay of the fuselage of the aircraft in illuminated conditions from a previous segment of the recording. This overlay was placed to help illustrate the aircraft's position in relation to ground lighting elements. Without the overlay, the aircraft's fuselage was not visible. The overlay was performed by utilizing the mask feature in Adobe Premiere. This mask has been applied to all subsequent screen captures included in this report.

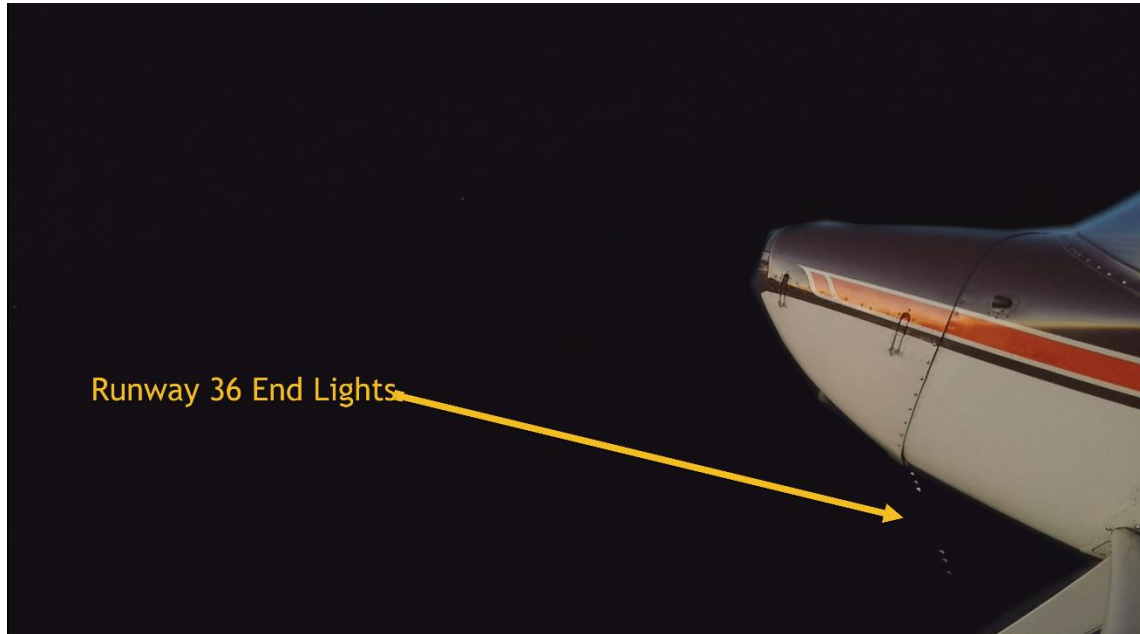


Figure 5. A screen capture taken at 19:48:24 and is entered to illustrate the position of the aircraft in relation to the departure runway as well as reference to the aircraft's attitude state at this time. NOTE: An overlay mask of the aircraft's fuselage in illuminated conditions has been added to this screen capture to help illustrate the position of the aircraft relative to the ground lighting.

Around 19:48:31, a sound consistent with the engine power being reduced was noted. The aircraft's wings wobbled gently. The aircraft continued in a gentle right turn through 19:48:35. Figure 6 is a screen capture of the aircraft at 19:48:35. The figure shows the runway lighting in the distance to the right of the aircraft which demonstrates the heading change of the aircraft after departure.

⁷ An illuminated portion of the aircraft's fuselage as seen in previous recordings has been added to demonstrate the attitude of the aircraft during night conditions.

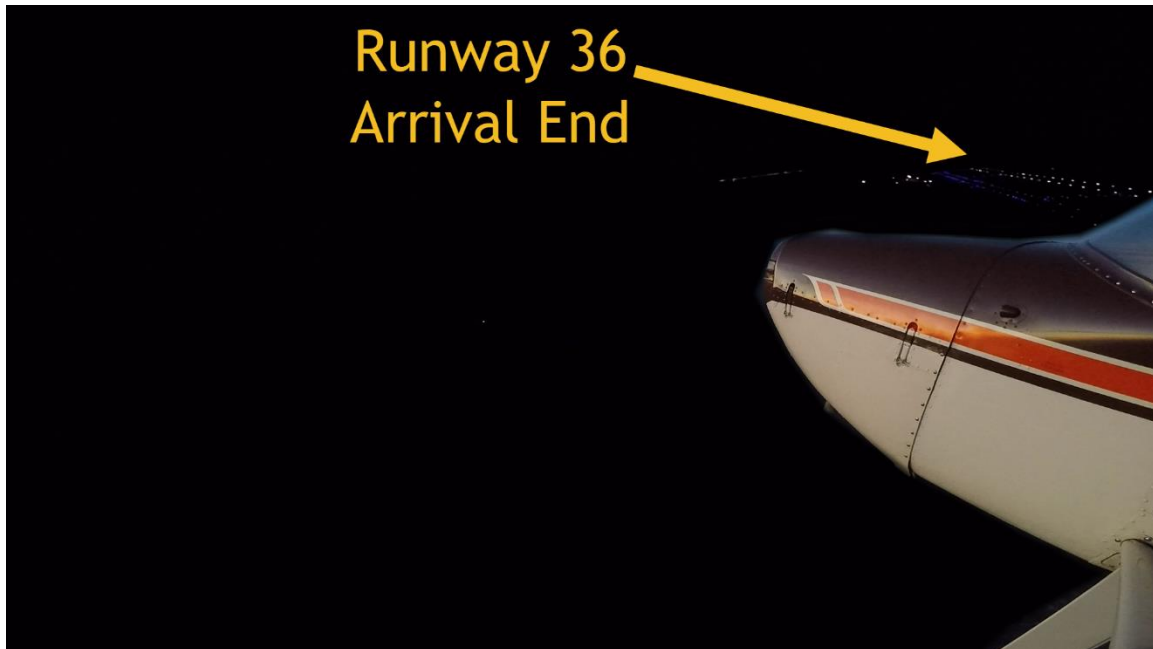


Figure 6. A screen capture taken at 19:48:35 which shows the aircraft's position in relation to the runway as well as the heading change of the aircraft after departure. NOTE: An overlay mask of the aircraft's fuselage in illuminated conditions has been added to this screen capture to help illustrate the position of the aircraft relative to the ground lighting.

From 19:48:35 onward, the aircraft entered a steepening right bank. The right bank was not consistent with the aircraft entering a spin. Figure 7 is a screen capture taken at 19:48:39. The figure has been annotated to show the airport beacon as well as a simulated horizon line based on available lighted visual references. The figure illustrates the nature of the aircraft's right bank at this time.

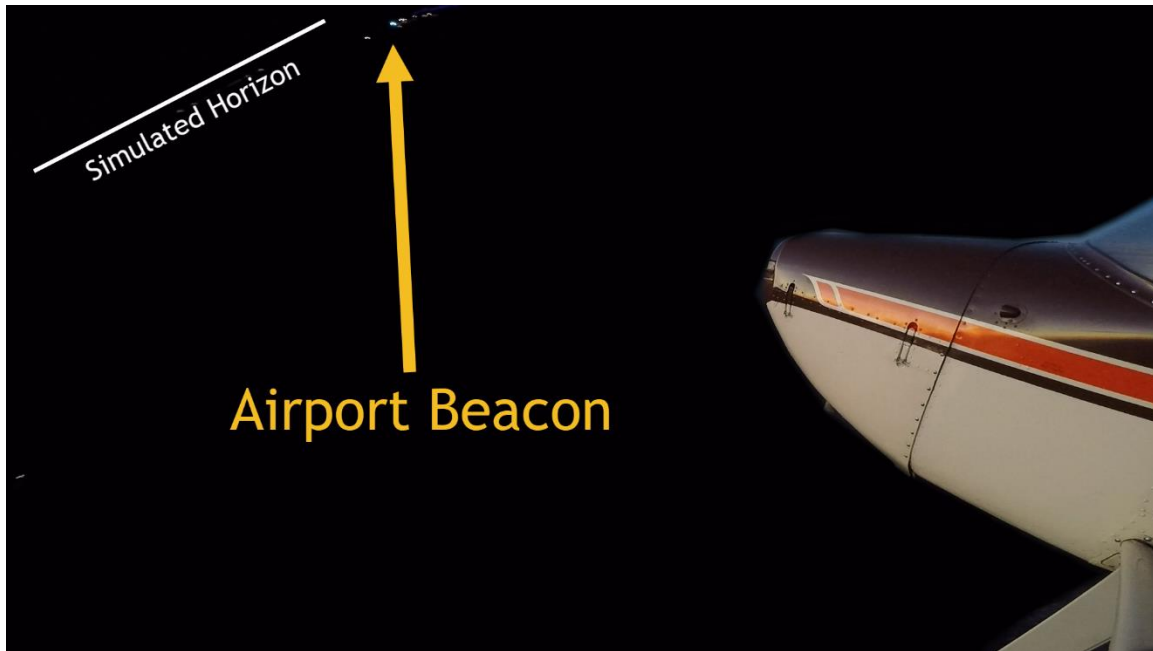


Figure 7. A screen capture taken at 19:48:39 which shows the aircraft's position in relation to the runway, airport beacon as well as the heading change and roll condition of the aircraft after departure. NOTE: An overlay mask of the aircraft's fuselage in illuminated conditions has been added to this screen capture to help illustrate the position of the aircraft relative to the ground lighting.

One second later, the rate of heading change increased to the right. The aircraft appeared to roll more aggressively right, but was not consistent with a spin entry. Figure 8 is a screen capture taken at 19:48:40. The screen capture has been annotated to show the direction to the airport beacon (not visible) as well as a simulated horizon line based on available lighted visual references. This is to illustrate the position of the aircraft in relation to the departure runway, as well as the bank angle.

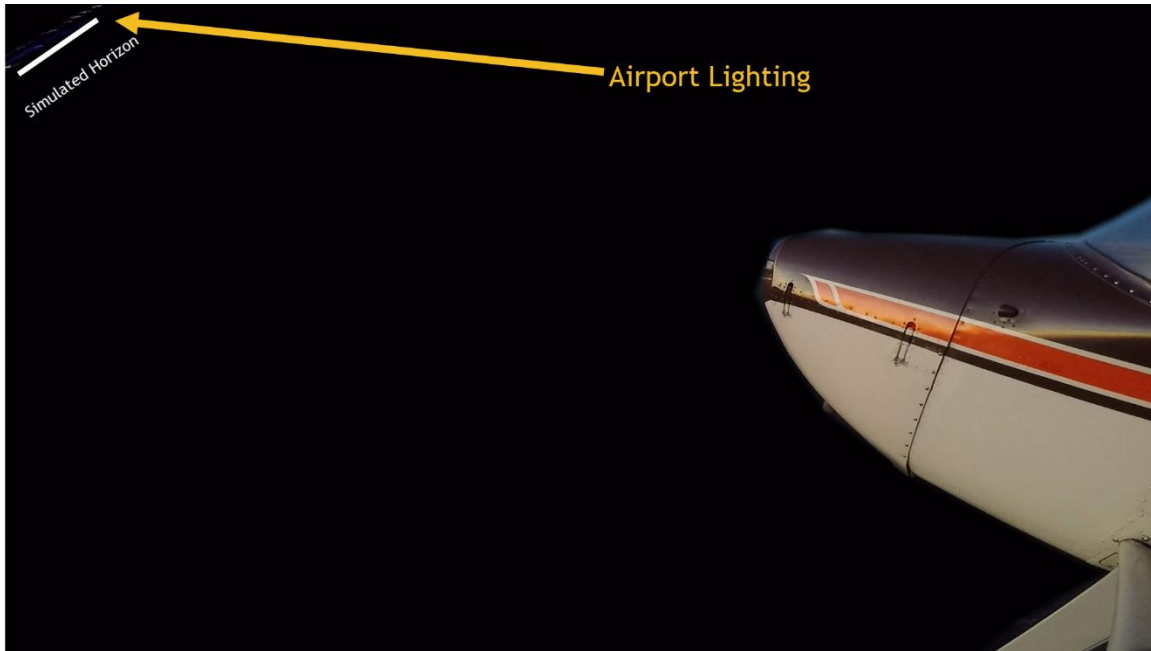


Figure 8. A screen capture taken at 19:48:40 illustrating the aircraft's position in relation to the departure runway as well as the aircraft's bank angle. NOTE: An overlay mask of the aircraft's fuselage in illuminated conditions has been added to this screen capture to help illustrate the position of the aircraft relative to the ground lighting.

As the aircraft continued in a right turn, the previously steepening bank angle had appeared to lessen. At 19:48:42, the sound of the engine was reduced to a near idle state. Some engine noise was present, but mostly aerodynamic noise was audible. Around this moment, all lighted visual references appeared to be lost to the camera, so any additional changes in pitch or bank could not be established.

Impact occurred at 19:48:43. The camera continued to record in darkness, no visual elements were obvious. Upon impact, a thud was audible, and engine and aerodynamic noise ceased. A sound consistent with vacuum instruments reducing in rotational speed was audible. There were no obvious sounds of occupants moving in the vicinity of the wreckage.

The camera continued to operate for another 57 minutes and 57 seconds until the recording ceased. The recovered file structure was consistent with a GoPro operating normally until battery exhaustion. Other than the sound of one aircraft passing overhead, there was nothing else remarkable about the remaining audio or video.

3.6. Summary of Additional Electronic Data (Metadata)

Some GoPro cameras record metadata which is embedded in the camera system's .mp4 video files. Some of this metadata can include, but is not limited to, GPS data, accelerometer data and accelerometer rate data. A custom software script was used to extract accelerometer and accelerometer rate data. The data set extracted from the accident recording was found to be lacking GPS position

data. It was determined that the acceleration and acceleration rate data alone could not be used to recreate a flight path and attitude state of the aircraft in the absence of GPS data in this scenario. To recover aircraft speeds and attitudes from this data would require angular rates and linear accelerations to be integrated simultaneously. Additionally, initial speeds and angles would need to be known to properly integrate this data. This data was not used in the accident investigation to form a reliable analysis.

Submitted by,

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